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Bulletin 56

GEOLOGY 5

DESCRIPTION OF THE STATE GEOLOGIC MAP OF 1901

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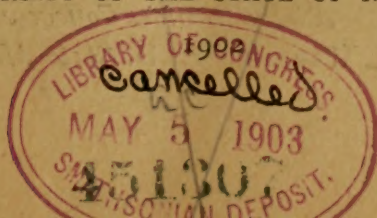
FREDERICK J. H. MERRILL Ph.D.

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Bulletin 56

GEOLOGY 5

DESCRIPTION OF THE STATE GEOLOGIC MAP OF 1901

PREFACE

The purpose of this bulletin is to give a certain amount of information which could not be expressed on the geologic map of 1901, namely the detailed credit for the material used in its compilation.

With this it has seemed worth while to give some items of general information about the history of geologic work in New York. The matter relating to the early Natural History Survey is in part based on an article by the late Dr James Hall in a publication entitled *Public Service in the State of New York*, which has been copiously quoted because of its convenient form, though the facts given are on record elsewhere.

In compiling a second edition of the geologic map of the State of New York, on the scale of 5 miles to the inch, the writer has found the task exceedingly complex. While the geology of New York has been carefully studied by many competent observers the lack of accurate maps has rendered much of the field work unavailable for graphic reproduction because many accurate observations could not be located. It also appears that in the earlier work the geologists have not understood the most practical methods of locating their observations, the practice seemingly having been to locate outcrops with reference to drainage rather than with reference to roads.

From the earliest times roads have been surveyed and their principal turns and angles have been located with sufficient accuracy to make them available for reference from one map to another. On the other hand, as the streams have rarely been surveyed and their meanderings have been represented in a conventional and conjectural manner, outcrops or boundaries referred to them are usually unavailable for plotting on an accurate base.

In offering the present map and its accompanying bulletin to the public, the author does not expect that he has been able to avoid errors and he earnestly asks the cooperation of all who are interested in the geologic map of New York to aid him in making it as accurate as possible by supplying corrections for a revised edition.

FREDERICK J. H. MERRILL

Albany N. Y. July 1902

The geologic map of New York, edition of 1901, is sold in atlas form for \$3. Mounted on rollers \$5.

INTRODUCTION

The geologic map of New York is a graphic expression of the general results of the geologic study of the rocks of the state. This study began as early as 1820 and has been carried on continuously, not only under state auspices, but by private and federal enterprise, and many valuable contributions have been made by geologists not in the state service.

A very complete bibliography of articles on New York geology will be found in bulletins of the United States Geological Survey, nos. 127, 130, 135, 146, 149, 156, 162 and 172.

HISTORY OF THE NEW YORK GEOLOGIC SURVEYS

In 1820 and 1821 Prof. Eaton, with the assistance of Drs T. Romeyn and Lewis C. Beck, under the patronage of Hon. Stephen Van Rensselaer, conducted an agricultural and geological survey of Rensselaer and Albany counties. These surveys, of which reports were published, were intended to serve the interests of agriculture, and were spoken of in the *American Journal of Science* as being the most extensive and systematic efforts of the kind made up to that period. In 1822, also under the patronage of Stephen Van Rensselaer, Mr Eaton undertook a geological and agricultural survey of the district adjoining the Erie canal. The report on this work was published in 1824, in a volume of 163 pages, with a geologic profile extending from the Atlantic to Lake Erie, and a "profile of rocks crossing part of Massachusetts" (from Boston harbor to Plainfield), by the Rev. Edward Hitchcock, who also furnished a description of the rocks and minerals crossed by this profile.

Much had already been done, therefore, to prepare the way, and the public mind was fully awake to the interests and importance of a geological survey, when the Albany Institute, in 1834, memorialized the Legislature for some action in that direction. In 1835 a similar petition was presented by the New York Lyceum of Natural History.

These memorials were referred to a committee of the Legislature of 1835, which recommended a resolution by which the secre-

tary of state was "requested to report to the Legislature at its next session, the most expedient method of obtaining a complete geological survey of the state, which shall furnish a scientific and perfect account of its rocks, soils and minerals, and of their localities; a list of all its mineralogical, botanical and zoological productions, and provide for procuring and preserving specimens of the same; together with an estimate of the expenses which may attend the prosecution of the design, and of the cost of publication of an edition of 3000 copies of the report, drawings and a geological map of the results."

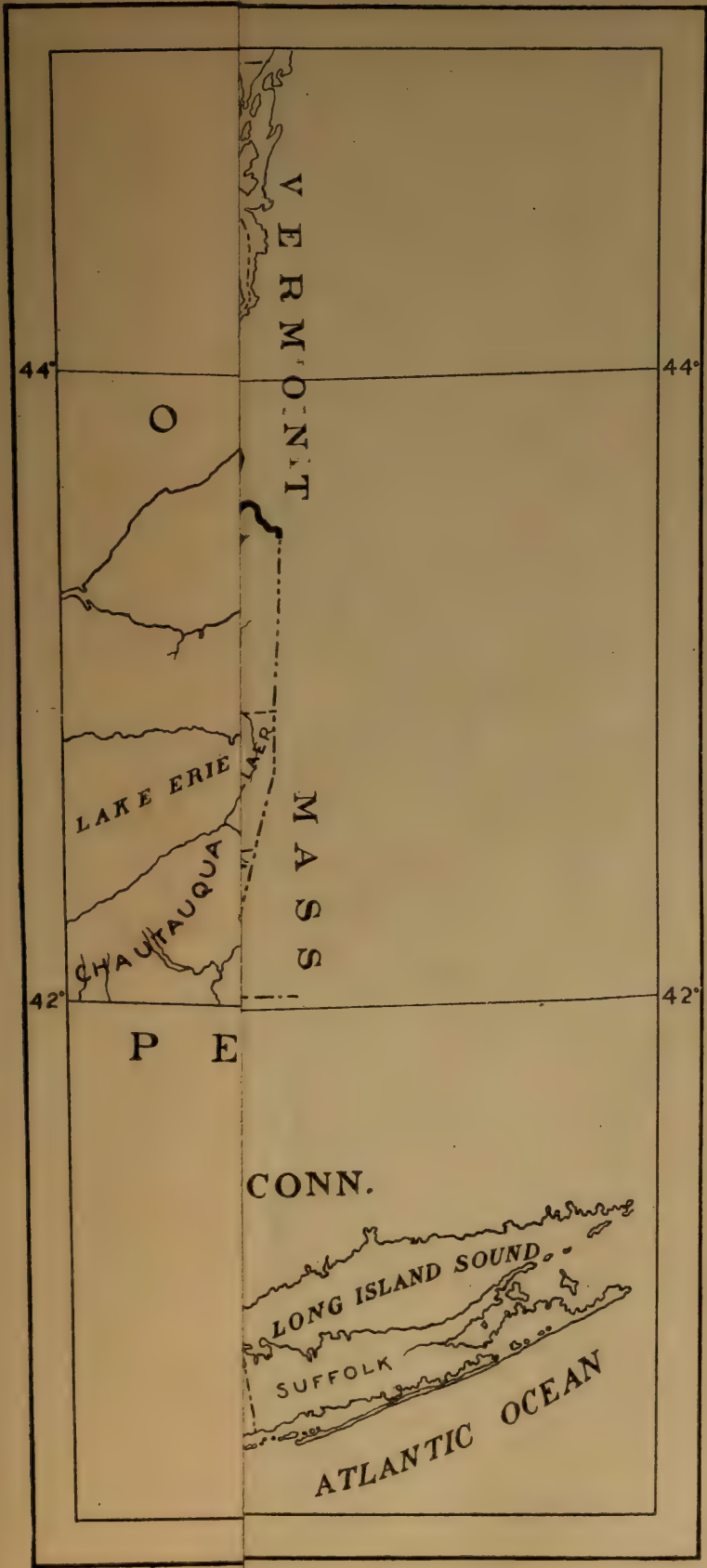
In pursuance of the request contained in this resolution, the secretary of state, Hon. John A. Dix, presented a report¹ at the session of the Legislature in 1836, which contained much valuable information with reference to what had already been done toward developing the mineral resources of the state, giving a summary of our knowledge of the subject at that time, and discussing several questions of great interest; for example, the salt and salt-bearing formations, our mineral springs and the probabilities of finding coal within the limits of the state. He also gave a statement of what had been done in other states, and of work in a similar direction elsewhere in progress or in contemplation.

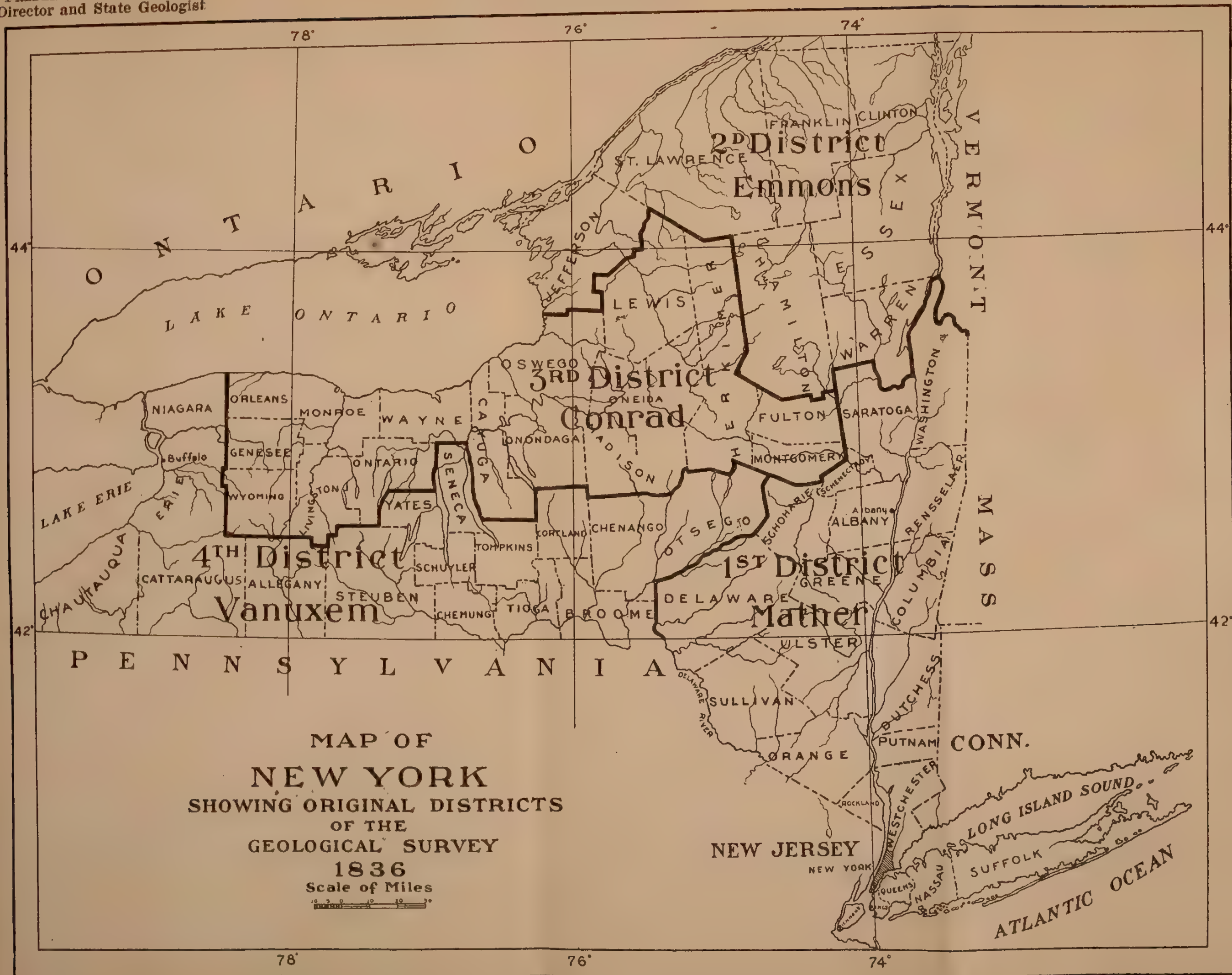
Under their distinctive heads, he discussed the botany and zoology of the state, and gave reasons why each should receive due attention.

The report concluded with the recommendation of a plan for the geological survey by a subdivision of the state into four districts, a plan which, with some modifications, was carried out in the final organization. This plan contemplated the employment of two geologists for each district, which was subsequently modified by the appointment of one geologist with an assistant, for each district. One mineralogist was appointed for the entire state, and also one botanist and one zoologist.

As shown by the accompanying maps, the first district con-

¹ Report of the secretary of state in relation to a geological survey of the state, dated Jan. 6, 1836. Assembly doc. no. 9, 1836.





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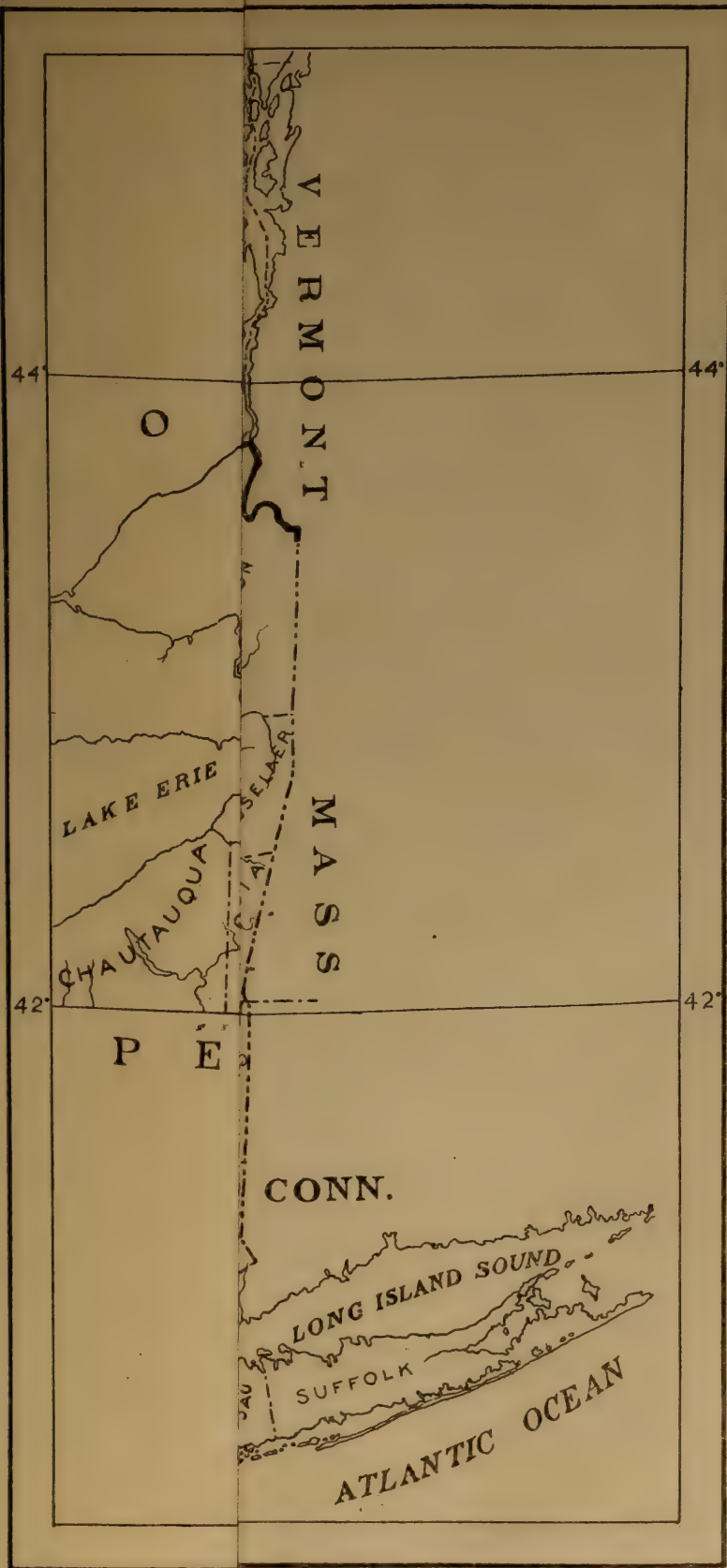
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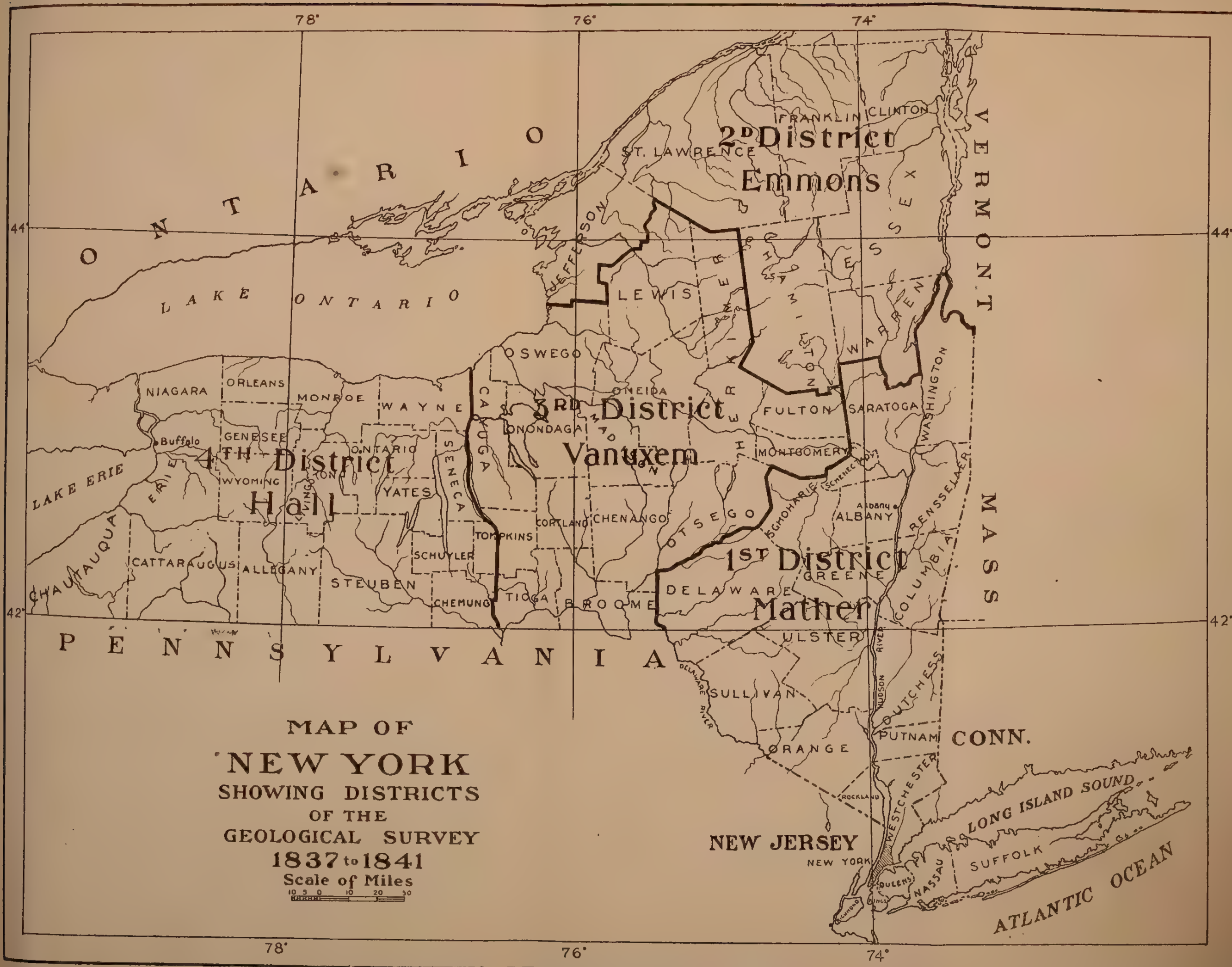
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sisted of the counties of Suffolk, Queens, Kings, Richmond, New York, Westchester, Rockland, Putnam, Dutchess, Orange, Sullivan, Delaware, Ulster, Greene, Columbia, Rensselaer, Albany, Schoharie, Schenectady, Saratoga and Washington, containing an area of 12,263 square miles.

The second district consisted of the counties of Warren, Essex, Franklin, Clinton, Hamilton, Jefferson and St Lawrence, making 10,817 square miles.

The third district comprised the counties of Fulton, Montgomery, Herkimer, Oneida, Lewis, Oswego, Madison, Onondaga, Cayuga, Wayne, Ontario, Monroe, Orleans, Genesee and Livingston, making, as reorganized, 11,468 square miles.

The fourth district consisted of the counties of Otsego, Chemung, Broome, Tioga, Cortland, Tompkins, Seneca, Yates, Steuben, Allegany, Cattaraugus, Chautauqua, Erie and Niagara, embracing an area of 11,594 square miles.

The third and fourth districts were afterward reorganized, making all the counties to the west of Cayuga lake, and a line drawn north and south from its two extremities, the fourth district, which contained 11,060 square miles.

During the session of 1836 the Legislature passed "an act to provide for a geological survey of the state," authorizing and directing the governor to "employ a suitable number of competent persons, whose duty it shall be, under his direction, to make an accurate and complete geological survey of this state, which shall be accompanied with proper maps and diagrams, and furnish a full and scientific description of its rocks, soils and minerals, and of its botanical and zoological productions, together with specimens of the same; which maps, diagrams and specimens shall be deposited in the State Library; and similar specimens shall be deposited in such of the literary institutions of this state as the secretary of state shall direct."

This act further provided for an annual appropriation for defraying the expenses, and required the persons employed to make an annual report to the Legislature on or before the first

day of February in each year, setting forth the progress made in the survey.

The appointments of the principal geologists were made as follows. Lieut. W. W. Mather, a native of Connecticut, who had lately resigned from the United States army, was assigned to the first district. Prof. Ebenezer Emmons, of Williams College, was assigned to the second district. Mr T. A. Conrad, of Philadelphia, was assigned to the third district, and Mr Lardner Vanuxem, of Bristol Pa., to the fourth district.

The mineralogic department was assigned to Dr Lewis C. Beck, a native of Albany, but at that time a professor in Rutgers College, New Jersey. Dr John Torrey, professor of chemistry and botany in the College of Physicians and Surgeons, New York, was commissioned as state botanist; and Dr James E. De Kay, of Long Island, as state zoologist.

The assistants in geology commissioned by the governor were: Caleb Briggs in the first geologic district, James Hall in the second, George W. Boyd in the third, and James Eights in the fourth district.

The instructions given to these officers were essentially the same as recommended in the report of the secretary of state. Each of the geologists was required to collect, in his own district, eight suites of rock specimens, but no conditions of this kind were imposed on the mineralogist, botanist or zoologist. A special draftsman was appointed for the zoologic department and also for the botanic department. The geologists were each allowed a small sum (\$300) annually to pay for the drawings of sections, maps, etc. which might be required for the illustration of their reports.

This, in brief, was the organization of the New York natural history survey at its commencement. At the end of the first year, it became evident to the geologists that the relations of the rock formations, the age and order of superposition, among the then unknown, or very imperfectly understood, stratified deposits, could be determined only on paleontologic evidence. They therefore unanimously recommended to the governor that

some competent person be appointed to devote himself to that department. To this position Mr Conrad was assigned, thus leaving a vacancy in the third geologic district, which, after a reorganization of its boundaries, as before explained, was assigned to the charge of Mr Vanuxem, and Mr Hall was appointed to the fourth district.

During the five years of field work which followed the New York geologists accumulated a vast amount of material and of facts regarding the geologic formations within the state, proving conclusively that they could not be parallel with any of the described and well determined formations of Europe. The Silurian system of Murchison, as described and illustrated in the *Edinburgh Review*, in 1838, and as finally published in 1839, though covering a portion of similar ground, was not broad enough to meet the requirements of the geology of New York. Thus failing to find the means of comparison and identification, the term "New York system," was proposed, to embrace the sedimentary formations from the Potsdam sandstone to the base of the Carboniferous system; or, as the formations were developed in New York and southerly into Pennsylvania, the upward extension of this term reached to the base of the Coal Measures. This term "New York system," included the formations ordinarily embraced by the names Cambrian, Silurian and Devonian in England and on the continent of Europe.

In 1842 Mr Conrad resigned his position as paleontologist of the survey without communicating any report to the governor; and the four geologists who had expected to avail themselves of the results of his investigations were left to their own resources. In this state of affairs, each one of the geologists illustrated his own report, as best he could, by figures of characteristic fossils of the rocks and groups which he had studied in his own district. By this means a very considerable number of the more common and characteristic fossils were illustrated in woodcuts, which were printed in the text, thus giving authentic guides for the determination of all the more important members of the series.

The incompleteness of the plan for the contemplated natural history survey of the state was recognized by the governor and Legislature; and it was also claimed that agricultural interests had not been sufficiently considered in the work already published. It was, therefore, decided that the department of paleontology should be reestablished, and that of agriculture be added to the plan of the work. The paleontology was committed to Mr James Hall, who entered on the work in 1844.

The agriculture of the state was reported on by Dr Ebenezer Emmons. The first of the series of five volumes bearing on this subject contained a somewhat detailed discussion of the general geology of the state, with a statement of the author's views regarding the "Taconic" system. A geologic map was prepared to accompany this volume, which was an almost exact reproduction of the geologic map of 1842, with the exception that the area considered by the author to be occupied by the Taconic system was so colored on the map, though not noted in the accompanying legend. This map was not widely distributed.

During the period from 1844 to 1892 little areal work was carried on, the work of Dr Hall being concentrated on paleontology, but between 1890 and 1892, part of the general museum appropriation had been used for geologic work by the writer.

In 1892 an appropriation was secured from the Legislature for the completion and publication of the geologic map of the state and considerable work was done in tracing boundaries. Subsequent to the publication of this map (the Hall map of 1894) small appropriations were annually made for field work and a certain amount of areal mapping was carried on under the direction of Prof. Hall till his death in 1898.

On the death of Prof. Hall the writer was appointed to succeed him as state geologist, while Dr John M. Clarke was appointed state paleontologist and the work of areal mapping has been continued as rapidly as appropriations would permit.

GEOLOGIC PROVINCES OF NEW YORK

The geologic formations of New York, by their lithologic influence on its physiography and topography, separate themselves into several natural divisions, which have invited and held the attention of many geologists who have devoted themselves to the study of one or another area according to their personal interest and experience.

The more prominent of these which have been made subjects of special study are the Adirondack crystallines, southeastern crystallines, metamorphic rocks of the New England border or Taconic range, Silurian and Lower Devonian rocks of the Mohawk valley region and the Upper Devonian rocks.

Adirondack crystallines

With the exception of a few unimportant papers previously published, geologic work on the pre-Cambrian rocks of the Adirondacks dates from 1837, the first year of field work of the Geological Survey of New York. In the division of the work adopted, by far the larger portion of the area in question fell to the share of Emmons, Vanuxem's district touching it in Lewis, Herkimer and Fulton counties only, while Mather had a small portion in Saratoga and Washington counties. Emmons described various classes of rock in his annual reports and in the final report on the second district, which appeared in 1842. These divisions were based on lithologic differences and were not shown on the 1842 map, on which the entire central mass of the Adirondacks is colored in one tint as "Primary." From 1842 till a comparatively recent date, little or no field work of value was carried on in that area, many of the papers published being in relation to the adoption of the names "Huronian" and "Laurentian" of Canadian geologists for subdivisions of the Adirondack series.

In 1895 Prof. J. F. Kemp, at the suggestion of the writer, took up a study of the region of the iron mines near Port Henry. The results of this work appeared in Museum bulletin 14. Subsequently work was continued under the direction of Prof. James Hall from 1896 to 1898, the study of the Adirondack area being divided between Professors Kemp, Cushing and Smyth.

Pre-Cambrian and metamorphic rocks of southeastern New York

Mather, in his final report of 1842, described the rocks of this area under two heads: metamorphic and primary. In the former he included the mica slates, quartzites and crystalline limestones; in the latter the granites, gneisses and igneous rocks. Though in deference to one of his colleagues, he had given space to the Taconic system, he stated that he believed it to consist merely of altered representatives of Champlain (Cambro-Silurian) age, and further says that the "metamorphic" rocks are probably of the same age, but still more highly altered. On the 1842 map, however, only the limestones are separated out and colored distinct from the "Primary gneisses and granites."

Forty years of reactionary ideas elapsed before the work of Dana and the writer verified Mather's statements, the interval being filled in with the publication of schemes of classification and theories of origin, in which the names Laurentian, Huronian, Norian and Montalban figured prominently. The difficulty of establishing these theories without actual field work was apparently not manifest to some of the authors.

The history of modern geologic work in the region dates back less than a quarter century. Dana, in the extension of his work on the Taconic rocks, carefully worked over Dutchess, Putnam, Westchester and New York counties; and correlated the crystalline limestones of the last two with the Cambro-Silurian limestones of Dutchess county. Failing, however, to differentiate the mica schist (Manhattan or Hudson) overlying the limestones (Inwood or Stockbridge) from the gneisses (Fordham) underlying them, his work lacked completeness. This want was supplied by the writer, who recognized the dissimilarity and true stratigraphic positions of the two noncalcareous formations, and correlated the Manhattan schist with the Hudson river slates and shales.¹ Detecting also the presence in these counties of a comparatively thin bed of quartzite (Lowerre) immediately below the limestones, he inferred its equivalence to the Cambrian quartzite of Dutchess county. The series was

¹Am. Jour. Sci. Ser. 3. 39:389; N. Y. State Mus. 50th An. Rep't. 1:21-31.

thus found to be complete and the positions of its members well established. Subsequently the positions and boundaries of these members have been located in detail throughout the southeastern counties by the writer and his assistants, Messrs Blake, Ries, Newland, Hill and Eckel.

The rocks of the Taconic range and adjoining areas

Most of the so called "Taconic" rocks fell, on the first geological survey of the state, within the district assigned to Mather, who appears to have recognized their true character and relationship. Emmons, however, insisted that they formed a separate and distinct system underlying the Silurian, and his views were accepted, under protest, by Mather in his final report. Owing to the later advocacy of Emmons's views by Hunt and Marcou, neither of whom performed any field work in the region, the "Taconic question" left a marked impression on the literature of New York and New England geology. The subsequent work of Dana and Walcott was, however, decisive, and since then the only problem has been the exact correlation, so far as exactness is possible, of these Taconic rocks with the unmetamorphosed strata of the Cambrian and Silurian formations.

So far as the area covered by Dale in his work on the slate belt falls within the limits of the 1901 map, his boundaries and correlations have been followed. Maps from several of his other papers have been used for smaller areas, while some areas on the eastern border are taken from the maps of Pumpelly and Emerson. Dwight's manuscript maps contributed for the occasion have been followed for most of Dutchess county, north of the Highlands.

With the exception of small areas near Lake Champlain, credited to Brainerd and Seely, the remaining part of the Paleozoic mapped east of the Hudson is from the work of Dana and Walcott. Dana's mapping covers a relatively small area in northeastern Dutchess and southeastern Columbia county and in the adjoining portions of Massachusetts and Connecticut; while Walcott's boundaries have been followed for most of Rensselaer and Washington counties and nearly all that part of Vermont which appears on the map of 1901.

Silurian and Lower Devonian

The most interesting problems connected with these formations are those of the proper systematic position of the Lower Helderberg and the mutual relations of the Medina sandstone, Oneida conglomerate and Oswego sandstone. The first subject has been discussed by Clarke, Williams, Stevenson and others; while the second remains to be investigated. The mapping of the Cambrian and Silurian formations in the Lake Champlain region is based on the work of Brainerd and Seely, Cushing, Kemp, van Ingen, Walcott and White, all save van Ingen's contribution having appeared in various papers.

The mapping of the pre-Hamilton rocks in the western and northern towns of Orange county is based on the work of Ries; that of the Schunemunk-Bearfort mountain area on Darton's, retraced on the Schunemunk and Ramapo atlas sheets by Eckel. With the exception of the small areas about Kingston and Hudson credited to Davis, Darton's work for the Hall map of 1894 served as the basis for the pre-Hamilton mapping of Ulster, Greene and Albany counties and for the westward extension of the Helderberg rocks across the state. His mapping of the Niagara limestone was also used, supplemented by later work by Sarle, who is to be credited with the Medina-Clinton and Clinton-Niagara boundaries from Oneida lake to Lockport, and with the Potsdam-Trenton, Trenton-Hudson and Hudson-Medina boundaries from near Boonville and Rome to Lake Ontario. Westward of Lockport a manuscript map by Gilbert and the recently published map by Grabau, of the vicinity of the Niagara river, were used. The mapping in Erie county south of Buffalo is based on the work of Bishop, with corrections by Clarke. The boundaries in Onondaga county are mainly as mapped by Luther; while small areas near Skaneateles, and in Oneida county near Oneida, Clinton and Utica were revised by Eckel.

In addition to the work on the areas specified above, Clarke and Luther made many manuscript corrections to the boundaries shown on the map of 1894 in the central and western part of

the state, the Hall map of 1894 being used where no information of later date was obtainable.

In the Mohawk valley the mapping of the Paleozoic is based largely on Darton's work under the direction of the late James Hall. The boundary between the Cambrian and the Silurian, north of the Adirondacks, is to be credited to Cushing. White's mapping, revised in some places by Eckel, was used for the Lower Silurian formations in most of Oneida county and in parts of Herkimer and Lewis.

The Upper Devonian and the Carboniferous

The mapping of the formations above the Onondaga on the present edition of the geologic map is based, east of the Chenango valley, on the work of Prosser, except in Albany county, where Darton's boundaries have been used. West of the Chenango valley it is based mainly on recent published and unpublished work of Dr John M. Clarke, aided by Luther in some areas, the portion not thus recently revised being copied from the Hall map of 1894. The position of the Tully limestone, first mapped by S. G. Williams, has been revised by Luther throughout most of its length and by Eckel in that portion appearing on the Ovid atlas sheet.

The Carboniferous outliers in the southwestern part of the state are as mapped, in manuscript, by Clarke after Randall, but are not considered by Dr Clarke to be very reliably determined.

Triassic to Pleistocene

The Triassic sandstone and diabase of Rockland county are as mapped by Kümmel. The pre-Pleistocene boundaries on Staten Island are based on the mapping of Hollick; the Pleistocene of Staten Island and Long Island are from the mapping of Woodworth and Woodman. Their respective areas were separated by the meridian of $73^{\circ} 30'$, Woodworth mapping all west and Woodman all east of that line. The continuation of the moraine across New Jersey and Pennsylvania is credited to Salisbury and Lewis.

LIST OF MAPS SHOWING GEOLOGY OF NEW YORK STATE

DATE	AUTHOR	AREA	SCALE TO INCH	MEDIUM OF PUBLICATION
1830..	Amos Eaton.....	N. Y.	30 m.	Geological Textbook
1842..	Geol. Survey N. Y.	N. Y.	12 m.	To accompany the geologic reports
1843..	James Hall.....	N. Y. & central western states	30 m.	Report on the 4th Geologic District of New York
1844..	Ebenezer Emmons.....	N. Y.	12 m.	To accompany the Report on the Agriculture of New York
1845..	Sir Charles Lyell.....	Canada & U. S.	125 m.	Travels in North America
1863..	Sir William Logan & James Hall.	Canada & northeastern U. S.	125 m.	Report on the Geological Survey of Canada
1865..		N. Y.	20 m.	On the margin of J. H. French's map of N. Y. state
1867..	Sir William Logan & James Hall.	Canada & northeastern U. S.	25 m.	Accompanying Report on the Geological Survey of Canada
1871..	Charles H. Hitchcock.....	N. Y.	25 m.	Asher & Adams's atlas of New York
1881..	Charles H. Hitchcock.....	U. S.	20 m.	Published for the author by Julius Bien & Co.
1882..	James Hall.....	N. Y.	38 m.	Public Service of the State of New York
1884..	W J McGee.....	U. S.	112 m.	U. S. Geological Survey. 5th report
1886..	Charles H. Hitchcock.....	U. S.	112 m.	American Institute of Mining Engineers. Transactions. v. 15
1886..	Charles H. Hitchcock.....	N. Y.	25 m.	10th Census Report, v. 15
1888..	Charles A. Ashburner.....	Southwestern N. Y.	25 m.	American Institute of Mining Engineers. Transactions. v. 16
1893..	W J McGee.....	U. S.	112 m.	U. S. Geological Survey. 14th report
1894..	Frederick J. H. Merrill.....	N. Y.	14 m.	N. Y. State Museum. Bul. 15; also New York at World's Columbian Exposition, 1893
1894..	James Hall.....	N. Y.	5 m.	N. Y. State Museum. Bul. 17
1897..	Frederick J. H. Merrill.....	N. Y.	25 m.	N. Y. State Museum. Bul. 19
1898..	Frederick J. H. Merrill.....	Relief map showing geologic systems of N. Y.	25 m.	
1901..	Frederick J. H. Merrill.....	N. Y.	5 m.	

EARLIER GEOLOGIC MAPS AND THEIR GEOGRAPHIC BASES**The maps of 1842 and 1844**

The condition of the geographic maps of New York in 1842 can best be shown by quoting the words of Prof. Hall.¹

Upon the organization of the Geological Survey of the State of New York, one of the first objects sought was a map for laying down the limits of the geological formations. At that time there were no accurate maps except of small parts of country, and the best resource was found in Burr's atlas of the state and county maps of the State of New York. There seems to have been no approximately correct geographic map of the state available for the use of the geologists in recording their observations. At the close of the survey a small map was engraved expressly for the use of the geologists in laying down the limits of the geological formations. This map from the eastern limits of the state adjoining Massachusetts, Connecticut and Vermont to its western extremity was about 28 inches, and its extreme limit from north to south along the eastern counties of the state or from the Canada line to Sandy Hook was 2 inches less than its extent from east to west, or 26 inches. The locations of towns, villages and postoffices were doubtless taken from the best maps extant, but these afforded very unsafe guides for locating the outcrops of the geological formations.

Emmons's map of 1844 was colored on the same base as the map of 1842.

In 1867 a geologic map of Canada and the northern and eastern United States was published by Sir William Logan, director of the Canadian Geological Survey. This map is on a scale of 25 miles to the inch, and is of interest in the present connection because of the fact that the geology of the United States was compiled for it by Prof. Hall. The geologic mapping of New York there shown is, therefore, the first authoritative revision of the 1842 geologic map of New York.

Of this map it is said that only three copies were sent to the United States. These were presented to Prof. James Hall, Prof. James D. Dana and the United States Coast Survey. A reproduction on the scale of 125 miles to the inch is contained in the atlas accompanying the report of progress of the Canadian Geological Survey for 1863.

¹N. Y. State Geol. 12th An. Rep't. 1893. p. 27.

In 1882 Dr Hall prepared a small black and white geologic map of the state on the scale of 38 miles to the inch to accompany a publication entitled *Public Service of the State of New York*.

In 1894 an "Economic and Geologic Map of the State of New York" was prepared by F. J. H. Merrill to illustrate the report of the board of managers of the exhibit of the State of New York at the World's Columbian exposition. The scale was 14 miles to the inch, and the detail was necessarily much generalized, but in some areas the geologic boundaries were based on more recent data than those shown on the large map prepared under the direction of Prof. Hall.

A later edition of this map was published in bulletin 15 of the New York State Museum, and a reprint of this edition is contained in the report on barge canal by the state engineer, 1901.

The geographic base of 1894

The base of 1894 was prepared for Prof. Hall in Washington under the direction of Mr W J McGee, from such cartographic material as was available at that date. The manuscript draft of the base was prepared by Messrs Klemroth and Torbert on the same scale as that of the publication. The engraving was done on copper by expert engravers of the United States Coast and Geodetic Survey, temporarily unemployed.

While this map is very beautifully engraved, it is not wholly accurate in its geography, owing to the incompleteness of the surveys of the state and the lack of good compilations of such surveys as had been carefully made.

An edition of 1000 copies was printed.

The geographic base of 1901

The lack of accurate geographic information concerning New York state at the time of the compilation of the base of the Hall map rendered it necessarily inaccurate and, though beautifully engraved on copper, the errors were so numerous, which could be corrected through the availability of later surveys at the time of preparing the new edition, that the cost of correcting the

copper plates would have been nearly as great as the expense of the original engraving. It was, therefore, decided to use for the new edition the less expensive method of photo-lithographic reproduction and leave to a future period, when the topographic survey of the state might be completed, the engraving of a new copper plate base of which the accuracy might be unquestioned.

The compilation of the manuscript geographic base was made by draftsmen under the supervision of Mr C. C. Vermeule, on the scale of $2\frac{1}{2}$ miles to the inch, using all atlas sheets that had been surveyed at that time. In areas for which atlas sheets had not yet appeared the most accurate county maps were followed. The lithographic work was done by Julius Bien & Co., and after the proofs of the base were submitted they were again revised with the help of all later topographic sheets that appeared up to the time of going to press. The compilation of the geology was made with great care, preparation for it being the compilation during the previous year of a manuscript map of the state on a scale of 12 miles to the inch, in order to bring together all the latest material and to form a definite idea of its adjustment. Detailed credit for the material used is given in the text of this bulletin and in the important work of adjustment the writer has been greatly aided by his assistant Mr E. C. Eckel. The drafting of the geologic boundaries on the new base was mainly done by Mr A. M. Evans to whose manual skill and geographic instinct much of the value of the map as an accurate reproduction is due.

It should be understood by those who use the map that a certain percentage of the boundaries shown on it are necessarily conjectural. Some, because they have not yet been carefully surveyed on topographic sheets; some because the extent of Quaternary deposits is so great as to render these boundaries, in a large measure, indeterminate. One of the more prominent examples of the latter class is the boundary between the Niagara and Salina formations, west of the Genesee river. It can not be promised that this boundary will ever be defined with any degree of certainty unless a very extensive system of borings be made.

COLOR SCHEME

The colors and patterns used for the expression of the geologic formations are as nearly as possible those adopted by the United States Geological Survey in its geologic maps. The adjustment of these conventions to so large a map has proved quite difficult, yet it is sufficiently close to be clearly intelligible to those familiar with the system in question.

ACKNOWLEDGMENTS FOR MATERIAL USED

The space necessary for a detailed acknowledgment of material used in the present edition of the geologic map of New York is so great that it was found impracticable to engrave it all on the map itself. In the following pages, therefore, a detailed acknowledgment is made for all material used.

**LIST OF CONTRIBUTING GEOLOGISTS WITH COUNTIES IN WHICH
THEIR CONTRIBUTIONS LIE****New York**

Bishop, I. P. Erie.

Clarke, J. M. Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Columbia, Cortland, Genesee, Herkimer, Livingston, Madison, Monroe, Oneida, Onondaga, Ontario, Otsego, Schuyler, Seneca, Steuben, Tioga, Tompkins, Wyoming and Yates.

Cumings, E. R. Schenectady.

Cushing, H. P. Clinton, Franklin, Herkimer and St Lawrence.

Dale, T. N. Rensselaer and Washington.

Dana, J. D. Columbia and Rensselaer.

Darton, N. H. Albany, Greene, Ulster, Orange, Saratoga, Herkimer, Fulton, Hamilton and Montgomery.

Davis, W. M. Columbia and Ulster.

Dwight, W. B. Dutchess and Columbia.

Eckel, E. C. Westchester, Putnam, Dutchess, Rockland, Orange, Oneida, Seneca and Yates.

Finlay, G. I. Essex.

Ford, S. W. Columbia.

- Gilbert, G. K. Niagara.
- Grabau, A. W. Niagara and Erie.
- Hall, James. Schoharie, Sullivan, Tioga, Tompkins, Ulster, Wayne, Delaware, Monroe, Livingston, Broome, Cayuga, Chenango, Cortland, Erie, Greene, Genesee, Herkimer, Madison, Oneida, Orleans and Otsego.
- Hill, B. F. Hamilton, Putnam, Washington, Dutchess, Fulton, Warren and Montgomery.
- Hollick, A. Richmond.
- Kemp, J. F. Essex, Fulton, Hamilton, Saratoga, Warren, Washington, Montgomery and Rockland.
- Kümmel, H. B. Rockland.
- Lincoln, D. F. Seneca.
- Luther, D. D. Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Cortland, Erie, Genesee, Livingston, Madison, Onondaga, Ontario, Seneca, Steuben, Tompkins, Wyoming and Yates.
- Merrill, F. J. H. Queens, New York, Westchester, Putnam, Dutchess, Ontario and Rockland.
- Newland, D. H. Dutchess, Putnam, Hamilton, Warren and Washington.
- Parsons, A. L. Livingston.
- Prosser, C. S. Schenectady, Otsego, Delaware, Schoharie, Greene, Orange, Sullivan, Albany, Ulster, Madison and Chenango.
- Ries, H. Westchester, Orange and Putnam.
- Sarle, C. J. Niagara, Orleans, Monroe, Wayne, Cayuga, Oneida, Oswego, Lewis, Jefferson and Madison.
- Smyth, C. H. jr. Hamilton, Herkimer, Jefferson, Lewis, St Lawrence and Oneida.
- van Ingen, G. Clinton and Essex.
- Walcott, C. D. Rensselaer, Washington and Columbia.
- White, T. G. Essex, Herkimer, Oneida and Lewis.
- Woodman, J. E. Nassau and Suffolk.
- Woodworth, J. B. Richmond, Kings, Queens and Nassau.

LIST OF GEOLOGIC MAPS USED IN PREPARATION

Clarke, J. M. New York State Geologist. 4th Annual Report.
1885. p. 9.

- 1 Geologic map of Ontario county.

———— New York State Geologist. 15th Annual Report.
1898.

- 2 Geologic map of Seneca, Schuyler, Yates and parts of Tompkins and Ontario counties. p. 60.

- 3 Geologic map of part of Chenango and Cortland counties. p. 42.

———— New York State Museum. Memoir 3. 1900. p. 12.

- 4 Geologic map of Becraft mountain.

Cushing, H. P. New York State Geologist. 15th Annual Report.
1898.

- 5 Geologic map of town of Champlain, Clinton co. p. 572.

- 6 Geologic map of Chazy town, Clinton co. p. 567.

- 7 Geologic map of town of Plattsburg, Clinton co. p. 556.

- 8 Geologic map of town of Beekmantown, Clinton co. p. 561.

- 9 Geologic map of town of Altona, Clinton co. p. 563.

- 10 Geologic map of towns of Plattsburg and Schuyler Falls, Clinton co. p. 553.

- 11 Geologic map of town of Peru, Clinton co. p. 550.

- 12 Geologic map of town of Ausable, Clinton co. p. 546.

- 13 Geologic map of town of Black Brook, Clinton co. p. 542.

- 14 Geologic map of town of Saranac, Clinton co. p. 539.

- 15 Geologic map of town of Dannemora, Clinton co. p. 536.

- 16 Map of Clinton co., showing boundary between Cambrian and pre-Cambrian formations. pl. 1, p. 503.
- 17 Map of Ellenburg, Clinton co. p. 553.
- New York State Geologist. 16th Annual Report. 1899.
- 18 Map of Potsdam-pre-Cambrian boundaries in Clinton, Franklin and St Lawrence counties. p. 4.
- 19 Map of a portion of towns of Potsdam and Pierrepont, St Lawrence co. p. 25.
- New York State Geologist. 18th Annual Report. 1900.
- 20 Geologic map of Franklin county.
- Dale, T. N.** United States Geological Survey. 13th Annual Report. 1893. pt 2, pl. 97.
- 21 Geologic map of the region between the Taconic range and the Hudson valley.
- United States Geological Survey. 19th Annual Report. 1899. pt 3, pl. 13.
- 22 Geologic map of the slate belt of eastern New York and western Vermont.
- Dana, J. D.** American Journal of Science. Ser. 3, no. 120. Dec. 1880. 20:450, pl. 8.
- 23 Map showing limestone areas of Dutchess, Westchester and Putnam counties, New York and a part of western Connecticut.
- American Journal of Science. Ser. 3, no. 171. Mar. 1885. 29:222, pl. 2.
- 24 Geologic map of Taconic region; pt 1, southern portion.
- American Journal of Science. Ser. 3, no. 197. May 1887. 33:432, pl. 11.
- 25 Geologic map of middle and northern Berkshire.
- Darton, N. H.** New York State Geologist. 14th Annual Report. 1895.

- 26 Preliminary geologic map of portions of Herkimer, Fulton, Montgomery, Saratoga and adjacent counties. p. 33.
- 27 Sketch map of region north of Mayfield, Fulton co. p. 46.
- New York State Geologist. 15th Annual Report. 1898. p. 738.
- 28 Preliminary map of Albany county.
- Ford, S. W. American Journal of Science. Ser. 3, no. 169. Jan. 1885. 29:17.
- 29 Map of Schodack Landing, Rensselaer co.
- Grabau, A. W. New York State Museum. Bulletin 45. 1901.
- 30 Geologic map of the Niagara river.
- Hall, James 31 Preliminary geologic map of New York state. 1894.
- Kemp, J. F. American Journal of Science. Ser. 3, no. 214. 1888. 36:248.
- 32 Geologic map of the vicinity of Rosetown, Rockland co.
- New York State Museum. Bulletin 14. 1895. p. 355.
- 33 Geologic map of towns of Moriah and Westport, Essex co.
- New York State Geologist. 15th Annual Report. 1898.
- 34 Geologic map of the town of Chesterfield, Essex co. p. 580.
- 35 Geologic map of the town of Wilmington, Essex co. p. 586.
- 36 Geologic map of the town of St Armand, Essex co. p. 588.
- 37 Geologic map of the town of North Hudson, Essex co. p. 590.
- 38 Geologic map of the town of Schroon, Essex co. p. 592.
- 39 Geologic map of the town of Ticonderoga, Essex co. p. 600.

- 40 Geologic map of the town of Minerva, Essex co.
p. 602.
- 41 Geologic map of the town of Newcomb, Essex co.
p. 604.
- 42 Geologic map of the town of Jay, Essex co.
p. 582.

———— New York State Museum. Bulletin 21. 1898. cov.
p. 2.

- 43 Geologic map of vicinity of Lake Placid.

Kemp and Newland, D. H. New York State Geologist. 17th
Annual Report. 1899.

- 44 Geologic map of the town of Putnam, Washing-
ton co. p. 512.
- 45 Geologic map of the town of Dresden, Washing-
ton co. p. 514.
- 46 Geologic map of the town of Whitehall, Wash-
ington co. p. 520.
- 47 Geologic map of Whitehall village and region to
the west. p. 522.
- 48 Geologic map of the town of Fort Ann, Wash-
ington co. p. 530.
- 49 Geologic map of the town of Bolton, Warren co.
p. 534.
- 50 Geologic map of the town of Chester, Warren co.
p. 536.
- 51 Geologic map of the town of Hague, Warren co.
p. 538.

Kemp, Newland and Hill, B. F. New York State Geologist. 18th
Annual Report. 1900.

- 52 Geologic map of the towns of Benson, Hope,
Wells, Lake Pleasant and Indian Lake, Hamil-
ton co. p. 141.
- 53 Geologic map of the vicinity of Wells village,
Hamilton co. p. 144.
- 54 Geologic map of the town of Johnsbury, War-
ren co. p. 158.

- 55 Geologic map of the town of Fort Ann, Washington co. p. 162.
- Kemp and Hill. New York State Geologist. 19th Annual Report. 1901.
- 56 Geologic map of the town of Caldwell, Warren co. p. 22.
- 57 Geologic map of the town of Queensbury, Warren co. p. 26.
- 58 Geologic map of the northern part of Saratoga county. p. 28.
- 59 Geologic map of the northern part of Fulton county. p. 29.
- 60 Outline map of the "Noses," Montgomery co. p. 32.
- Kümmel, H. B. New York State Geologist. 18th Annual Report. 1900.
- 61 Geologic map of Triassic rocks of Rockland county.
- Lincoln, D. F. New York State Geologist. 14th Annual Report. 1895.
- 62 Geologic map of Seneca county.
Map omitted from v. 2 of 48th museum report, where it should also have appeared.
- Luther, D. D. New York State Geologist. 15th Annual Report. 1898.
- 63 Geologic map of the town of Naples, Ontario co. p. 236.
- 64 Geologic map of Onondaga county. p. 302.
- Merrill, F. J. H. New York State Museum. Bulletin 15. 1895. p. 595.
- 65 Geologic map of a part of southeastern New York.
- Prosser, Charles S. New York State Geologist. 15th Annual Report. 1898. p. 87.
- 66 Geologic map of parts of Chenango, Madison, Otsego, Schoharie and Albany counties.
- New York State Geologist. 17th Annual Report. 1899. p. 66.

- 67 Geologic map showing the distribution of the Middle and Upper Devonian rocks in central-eastern New York.

Prosser, C. S.; Cumings, E. R.; Fisher, W. L. New York State Museum. Bulletin 34. 1900. cov. p. 2.

- 68 Amsterdam N. Y. quadrangle.

Ries, Heinrich. American Geologist. 1896. 18:240.

- 69 Augen gneiss area near Bedford N. Y.

———— New York State Geologist. 15th Annual Report. 1898.

- 70 Orange county. p. 395.

- 71 Town of Warwick, Orange co. p. 408.

- 72 Towns of Monroe, Woodbury, Highlands, Cornwall and a part of the town of Blooming Grove, Orange co. p. 414.

- 73 Area around Bull hill, Orange co. p. 423.

- 74 Geologic map and sections of regions west of Cornwall, Orange co. p. 427.

- 75 Geologic map of the town of Chester, Orange co. p. 428.

- 76 Geologic map of the town of Deer Park, Orange co. p. 470.

- 77 Geologic map of the town of Hamptonburgh, Orange co. p. 472.

- 78 Geologic map of the towns of Newburgh and New Windsor, Orange co. p. 476.

Smyth, C. H. jr. New York State Geologist. 19th Annual Report. 1901. p. 85.

- 79 Geologic map of portions of St Lawrence and Jefferson counties.

Walcott, C. D. American Journal of Science. Ser. 3, no. 208. 1888. 35:346, pl. 3.

- 80 Map of the Taconic region.

White, T. G. New York Academy of Sciences. Transactions. 1894. 13:6.

- 81 Geologic map of towns of Essex and Willsboro, Essex co.

————— New York State Museum. 51st Annual Report.
1899.

82 Geologic map of the pre-Cambrian border in
Oneida and Lewis counties. p. r54.

83 Geologic map of the vicinity of Frankfort Hill.
p. r54.

LIST OF AUTHORITIES FOR THE COUNTIES OF NEW YORK

Albany. Below top of Hamilton, Darton (28); corrected as to Oriskany in towns of Knox and New Scotland by Clarke; above base of Hamilton, Prosser (67).

Allegany. Portage-Chemung boundary by Clarke and Luther. Areas of Catskill in Hall (31) omitted.

Broome. Hall (31) corrected by Clarke and Luther in towns of Triangle and Lisle.

Cattaraugus. Clarke and Luther. Carboniferous compiled by Clarke after Randall.

Cayuga. Hall (31) corrected in towns of Aurelius and Springport and city of Auburn by Clarke; Tully and Genesee-Portage boundaries by Clarke and Luther; Clinton by Sarle.

Chautauqua. Clarke and Luther.

Chemung. Clarke and Luther.

Chenango. Hall (31); west of Chenango river; Clarke (3) and manuscript; east of Chenango river, Prosser (66).

Clinton. Cushing (5-18 incl.); with corrections and additions by Cushing.

Columbia. Eastern part, Dana (24, 25); northwest part, Walcott (80); region about Hudson, Clarke (4); Cambrian boundary at Hudson river, Ford (29); remainder of county by Dwight.

Cortland. Clarke (3), Hall (31) corrected by Clarke and Luther.

Delaware. Hall (31), Prosser (66) upper and lower boundaries of Ithaca, Oneonta-Chemung boundary west of Meredith.

Dutchess. Town of Pawling by Merrill except pre-Cambrian boundary from Whaley Pond to northern limit of this formation by Hill; town of Amenia from Wassaic northward by Merrill;

pre-Cambrian and Cambrian of Dover mountain by Eckel; town of Fishkill by Newland and Eckel; East Fishkill and Beekman by Hill; other boundaries by Dwight.

Erie. Hall (31) corrected by Clarke and Luther and I. P. Bishop; Salina-Onondaga boundary near Buffalo, Grabau (30).

Essex. Kemp (33-43) and manuscript; town of Minerva, Finlay; Willsboro Point by White (81) corrected by Kemp; Crown Point Paleozoic corrected by van Ingen.

Franklin. Cushing (18, 20) corrected by Cushing.

Fulton. Darton (26, 27); Kemp and Hill (59).

Genesee. Onondaga and below Hall (31), corrected by Clarke in towns of Alabama, Pembroke and Leroy; above base of Hamilton by Clarke and Luther.

Greene. Hall (31), Oneonta-Chemung and Chemung-Catskill; upper and lower boundaries of Ithaca, Prosser (67).

Hamilton. Northwestern part by Smyth, eastern part, Kemp (52, 53).

Herkimer. Hall (31), corrected in town of Litchfield by Clarke; Little Falls crystalline area by Cushing, White (83); Darton (26).

Jefferson. Pre-Cambrian boundaries, Smyth (79); Paleozoic boundaries above base of Potsdam by Sarle.

Kings. Woodworth.

Lewis. Pre-Cambrian, White (83) and Smyth; others by Sarle.

Livingston. Hall (31), corrected in towns of Caledonia and Lima by Clarke; top of Hamilton to base of Chemung, Clarke and Luther; corrected in town of Mount Morris by A. L. Parsons.

Madison. Hall (31) corrected as to Lower Helderberg by Clarke; Prosser (66); Tully by Luther; Clinton-Niagara and Niagara-Salina by Sarle.

Monroe. Hall (31) corrected in towns of Brighton, Mendon, Rush and Wheatland by Clarke; Medina-Clinton and Clinton-Niagara boundaries by Sarle.

Montgomery. Darton (26); "Noses" area, Kemp and Hill (60).

Nassau. West of $70^{\circ} 30'$ by Woodworth; east of that meridian by Woodman.

New York. Merrill (65).

Niagara. Region near Niagara river, Grabau (30); Clinton other boundaries by Gilbert and Sarle.

Oneida. Hall (31), corrected in towns of Augusta, Marshall and Paris by Clarke, in Kirkland by Smyth, and in Paris, Kirkland and Vernon by Eckel; below top of Niagara by Sarle and White (82, 83).

Onondaga. Luther (64), corrected as to Helderberg and Salina by Clarke; Tully resurveyed by Luther.

Ontario. Clarke (1, 2), corrected by Clarke; Tully by Luther. Boundaries in towns of Seneca, Phelps and city of Geneva by Merrill after well records.

Orange. Schunemunk area of Paleozoic rocks by Darton; east and south of that area by Eckel; west and north of the Schunemunk area, Ries (70-78); Deer Park, Prosser (67).

Orleans. Hall (31), adjusted to topography.

Oswego. Sarle.

Otsego. Hall (31) below Hamilton; above base of Hamilton, Prosser (67); corrected in towns of Laurens and New Lisbon by Clarke.

Putnam. Southern parts of Phillipstown and Putnam Valley, Merrill (65); Patterson, East Kent and southern Southeast by Merrill; limestones between Anthony's Nose and Cold Spring and in valleys of Sprout brook and Canopus creek by Newland; remainder of the county from reconnaissance by Hill.

Queens. Crystalline rocks, Merrill (65); Pleistocene by Woodworth.

Rensselaer. Rensselaer grit plateau and vicinity, Dale (21); portions of the southeast part, Dana (25); remainder, Walcott (80).

Richmond. Pre-Pleistocene by Hollick; Pleistocene by Woodworth.

Rockland. Triassic, Kummel (61); pre-Cambrian and Paleozoic boundaries in town of Stony Point, Merrill; towns of Ramapo and Haverstraw by Eckel; eruptives near Rosetown, Kemp (32).

St Lawrence. Smyth (79) and Cushing (18); corrected by Cushing.

Saratoga. Darton (26); Kemp (58).

Schenectady. Darton (26); except Amsterdam quadrangle by Cumings and Prosser (68).

Schoharie. Hall (31); top of Hamilton and Ithaca-Oneonta boundaries by Prosser (66 and 67).

Schuyler. Clarke (2). Relation of Ithaca and Naples beds of the Portage group diagrammatically shown as necessitated by map patterns.

Seneca. Lincoln (62), corrected by Clarke and Luther; Tully limestone within Ovid quadrangle by Eckel; relation of Ithaca and Naples beds of Portage, Clarke (2), diagrammatically shown as necessitated by patterns of map.

Steuben. Clarke and Luther.

Suffolk. Woodman.

Sullivan. Hall (31); top of Hamilton and above, Prosser (67).

Tioga. Hall (31).

Tompkins. Hall (31); Clarke (2); and Tully and Genesee, Luther.

Ulster. Hall (31); top of the Hamilton and above, Prosser (67).

Warren. Kemp, Newland and Hill (49-51, 54, 56, 57), corrected by Kemp.

Washington. Kemp and Hill (44-48, 55); Dale (22); Walcott (81).

Wayne. Niagara-Salina boundary by Hall (31); others by Sarle.

Westchester. Merrill (65); except in town of Bedford, Ries (69); and in towns of Cortlandt, Yorktown, Somers, North Salem, Lewisboro, Poundridge, Bedford, North Castle, Newcastle and Harrison by Eckel.

Wyoming. Clarke and Luther.

Yates. Genesee-Portage and Portage-Chemung, Clarke (2) corrected by Clarke and Luther; Tully limestone by Luther except near Dresden by Eckel.

LIST OF AUTHORITIES FOR CONNECTICUT, MASSACHUSETTS, VERMONT, NEW JERSEY AND PENNSYLVANIA

Connecticut. Dana (23, 24 and 25) modified by unpublished results of reconnaissance by Eckel in towns of Greenwich, Stamford, New Canaan and Darien and H. C. Magnus in towns of Salisbury and Sharon.

Massachusetts. Dana (24, 25) except in the area covered by Dale (21 and the geologic map of Monument mt, U. S. Geol. Sur., 14th An. Rep't), Emerson (U. S. Geol. Sur. Bul. 259 and U. S. Geol. Sur. Monograph 23, pl. 1), Pumpelly, Dale, Wolff and Hobbs.

Vermont. Walcott (80); Dale (22); and Brainerd and Seely.

New Jersey. J. C. Smock (New Jersey geologic map of 1890); except Green Pond mt region, by Darton (Geol. Soc. Am. Bul. 5: 367) as engraved on the Hall map (31); area about Franklin by Wolff and Brooks (U. S. Geol. Sur. 19th An. Rep't); moraine by Salisbury (N. J. state geologist. Rep't 1895).

Pennsylvania. I. C. White (G 6), H. C. Lewis (Q), Frederick Prime jr (D 3) and B. S. Lyman (2d Geol. Sur. Summary Rep't, v. 3)

MANUSCRIPT MAPS

A number of manuscript maps and manuscript corrections embodying the results of unpublished field work, were used in the compilation of the geology of the present map.

A manuscript map of the boundaries above the base of the Portage from Cayuga lake westward was supplied by Dr John M. Clarke, state paleontologist, embodying the results of field work by himself and his assistant, Mr D. D. Luther up to 1898.

Dr Clarke also contributed, as noted above, numerous manuscript corrections of existing maps.

Mr C. J. Sarle, who had been engaged under Prof. James Hall in field work on the Upper Silurian formations of the central and western parts of the state, contributed manuscript maps showing the results of this work.

Mr N. H. Darton, whose mapping of the rocks of the Helderberg escarpment had been used on the Hall map, contributed his original manuscript drafts.

For the Adirondack area Professors Cushing, Kemp and Smyth mapped in manuscript their respective areas of work, much of which had been left uncovered by their published maps. Several of the maps used in manuscript have since been published.

Manuscript maps by G. K. Gilbert, covering parts of the Upper Silurian area of Niagara county and a revision by I. P. Bishop of parts of his map of Erie county were also used.

Prof. W. B. Dwight contributed in manuscript the results of his field work in Dutchess county.

In southeastern New York, field work by the writer and his assistants furnished a large amount of unpublished material.

Long Island was mapped in manuscript by Prof. J. B. Woodworth and his assistant, J. E. Woodman, as the result of field work for the State Museum. Part of the area thus covered has since been described with accompanying maps in Museum bulletin 48.

NOMENCLATURE OF NEW YORK GEOLOGY

In selecting names to be applied to the formations shown on the map the attempt has been made to render it as serviceable as possible to the teacher and student by keeping its nomenclature as close as possible to the mass of older textbooks now in use.

In so doing the editor has not followed in every case the latest expression in terminology or classification, and has not undertaken to decide the merits of any question at issue.

Perhaps the most prominent question of geologic classification in New York now under discussion is that of the systematic position of the Helderberg limestone; namely whether it should be regarded as Silurian or Devonian. Dr John M. Clarke, state paleontologist, after exhaustive study, has expressed the opinion that in this formation fossils of Devonian aspect appear and that it should, consequently, be included in the Devonian system. Prof. H. S. Williams, attacking the question from another point of view, in his studies of the Paleozoic formations of Maine,¹

¹U. S. Geol. Sur. Bul. 165, p. 56.

finds the Square Lake limestone which he correlates by its fossils with the Helderberg formation of New York and above it the Chapman sandstone in which he finds forms representative of the Silurian Tilestone fauna of Great Britain. From this he argues that, inasmuch as these Silurian fossils occur in a formation more recent than the Helderberg limestone, the latter should be regarded as Silurian.

So far as the writer understands from the literature to which he has access, the authors referred to, do not dispute each other's identifications of fossils. The question then seems to hang on the definition of a system; Dr Clarke holding that the system begins where its faunas first appear, while Prof. Williams holds that a system continues as far as its faunas linger, the definition of a system having, apparently, not been previously fixed. The question would, therefore, seem to remain open till the majority of geologists take the one side or the other.

On inquiring the opinion of the director of the United States Geological Survey, he expressed the view that the matter was still unsettled and so it is left by the present writer, the Helderberg being for the purposes of the present map classified in the Silurian system according to the arrangement adopted by Prof. Hall in the geologic map of 1894.

The classification of Oneonta, Ithaca and Portage formations as given on the map is based on a paper by Dr John M. Clarke in the 15th annual report of the state geologist, in which these formations, though regarded as essentially of equal age, lying between Hamilton and Chemung, are treated as separate groups. In the classification printed by Dr Clarke in Memoir 3 of the New York State Museum, he proposes to give the name of Portage group to the aggregate of the three formations and use the term Naples for the formation designated in the previous paper as the Portage group.

The following table shows the progress made in the terminology and classification of the rocks of New York since the beginning of geologic study within its area.

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COMPARATIVE TABLE OF GEOLOGIC NOMENCLATURE USED IN NEW YORK STATE PUBLICATIONS

[illegible]

Conrad 1837, Vanotem 1838, Emu 1839, Maiber 1839, Maiber 1840, Vanotem 1840 and names

* (62) 70122 25410

1911 104 85 62

; The stratum used on the geologic maps of 1891 and 1893 relates only to those deposits and formations which could be shown on the map.

§ The Chazy limestone has been regarded by geologists as lying below the Birdays, but these two formations do not appear to occur together at any locality.

Small capitals indicate earliest occurrence of terms used in present systems of nomenclature.

: Term Salina first used by Dana, *Manual of Geology*, 1st ed. 1862.

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University of the State of New York

New York State Museum

MUSEUM PUBLICATIONS

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All publications are in paper covers, unless binding is specified.

Museum annual reports 1847–date. *All in print to 1892, 50c a volume, 75c in cloth; 1892–date, 75c, cloth.*

These reports are made up of the reports of the director, geologist, paleontologist, botanist and entomologist, and museum bulletins and memoirs, issued as advance sections of the reports.

Geologist's annual reports 1881–date. Rep'ts 1, 3–13, 17–date, O.; 2, 14–16, Q.

The annual reports of the early natural history survey, 1836–42 are out of print.

Reports 1–4, 1881–84 were published only in separate form. Of the 5th report 4 pages were reprinted in the 39th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891), 13th (1893) are omitted from the 45th and 47th museum reports.

Separate volumes of the following only are available.

Report	Price	Report	Price	Report	Price
12 (1892)	\$.50	16	\$1	19	\$.40
14	.75	17	.75	20	.50
15	1	18	.75		

In 1898 the paleontologic work of the State was made distinct from the geologic and will hereafter be reported separately.

Paleontologist's annual reports 1899–date.

See fourth note under Geologist's annual reports.

Bound also with museum reports of which they form a part. Reports for 1899 and 1900 may be had for 20c each. Beginning with 1901 these reports will be issued as bulletins.

Botanist's annual reports 1869–date.

Bound also with museum reports 22–date of which they form a part; the first botanist's report appeared in the 22d museum report and is numbered 22.

Reports 22–41, 48, 49, 50 and 52 (Museum bulletin 25) are out of print; 42–47 are inaccessible. Report 51 may be had for 40c; 53 for 20c; 54 for 50c. Beginning with 1901 these reports will be issued as bulletins.

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have been published in volumes 1 and 3 of the 48th museum report and in volume 1 of the 49th, 51st and 52d reports. The botanical part of the 51st is available also in separate form. The descriptions and illustrations of edible and unwholesome species contained in the 49th, 51st and 52d reports have been revised and rearranged, and combined with others more recently prepared constitute Museum memoir 4.

Entomologist's annual reports on the injurious and other insects of the State of New York 1882–date.

Bound also with museum reports of which they form a part. Beginning with 1898 these reports have been issued as bulletins. Reports 3–4 are out of print, other reports with prices are:

Report	Price	Report	Price	Report	Price
1	\$.50	8	\$.25	13	\$.10
2	.30	9	.25	14 (Mus. bul. 23)	.20
5	.25	10	.35	15 (" 31)	.15
6	.15	11	.25	16 (" 36)	.25
7	.20	12	.25	17 (" 53)	.30

Reports 2, 8–12 may also be obtained bound separately in cloth at 25c in addition to the price given above.

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Bulletins are also found with the annual reports of the museum as follows:

Bulletins	Report	Bulletins	Report	Bulletins	Report
12–15	48, v. 1	20–25	52, v. 1	35–36	54, v. 2
16–17	50 “	26–31	53 “	37–44	“ v. 3
18–19	51 “	32–34	54 “	45–48	“ v. 4

The letter and figure in parenthesis after the bulletin number indicate the division and series number. G=geology, EG=economic geology, Z=general zoology, A=archeology, M=mineralogy, P=paleontology, B=botany, E=entomology, Misc=miscellaneous.

Volume 1. 6 nos. \$1.50 in cloth

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- 2 (B1) Peck, C: H. Contributions to the Botany of the State of New York. 66p. 2pl. May 1887. [35c]
- 3 (EG1) Smock, J: C. Building Stone in the State of New York. 152p. Mar. 1888. *Out of print.*
- 4 (M1) Nason, F. L. Some New York Minerals and their Localities. 20p. 1pl. Aug. 1888. 5c.
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- 6 (E2) ——— Cut-worms. 36p. il. Nov. 1888. 10c.

Volume 2. 4 nos. [\$1.50] in cloth

- 7 (EG2) Smock, J: C. First Report on the Iron Mines and Iron Ore Districts in New York. 6+70p. map. June 1889. *Out of print.*
- 8 (B2) Peck, C: H. Boleti of the United States. 96p. Sep. 1889. [50c]
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- 10 (EG3) Smock, J: C. Building Stone in New York. 210p. map. tab. Sep. 1890. 40c.

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- 11 (EG4) Merrill, F: J. H. Salt and Gypsum Industries in New York. 92p. 12pl. 2 maps, 11 tab. Ap. 1893. 40c.
- 12 (EG5) Ries, Heinrich. Clay Industries of New York. 174p. 2pl. map. Mar. 1895. 30c.
- 13 (E3) Lintner, J. A. Some Destructive Insects of New York State; San José Scale. 54p. 7pl. Ap. 1895. 15c.
- 14 (G1) Kemp, J. F. Geology of Moriah and Westport Townships, Essex Co. N. Y., with notes on the iron mines. 38p. 7pl. 2 maps. Sep. 1895. 10c.
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Volume 4

- 16 (A1) Beauchamp, W: M. Aboriginal Chipped Stone Implements of New York. 86p. 23pl. Oct. 1897. 25c.
- 17 (EG7) Merrill, F: J. H. Road Materials and Road Building in New York. 52p. 14pl. 2 maps 34x45, 68x92cm. Oct. 1897. 15c. Maps separate 10c each, two for 15c.
- 18 (A2) Beauchamp, W: M. Polished Stone Articles used by the New York Aborigines. 104p. 35pl. Nov. 1897. 25c.
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 Supplement to 14th report of the State entomologist.
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 35 (EG9) Ries, Heinrich. Clays of New York: their Properties and Uses. 456p. 140pl. map. June 1900. \$1, cloth.
 36 (E10) Felt, E. P. 16th Report of the State Entomologist 1900. 118p. 16pl. Mar. 1901. 25c.

Volume 8

- 37 (E11) ——— Catalogue of Some of the More Important Injurious and Beneficial Insects of New York State. 54p. il. Sep. 1900. 10c.
 38 (Z5) Miller, G. S. jr. Key to the Land Mammals of Northeast North America. 106p. Oct. 1900. 15c.
 39 (P2) Clarke, J: M.; Simpson, G: B. & Loomis, F: B. Paleontologic Papers 1. 72p. il. 16pl. Oct. 1900. 15c.

Contents: Clarke, J: M. A Remarkable Occurrence of Orthoceras in the Oneonta Beds of the Chenango Valley, N. Y.

—— Paropsonema Cryptophya; a Peculiar Echinoderm from the Intumescens-zone (Portage Beds) of Western New York.

—— Dictyonine Hexactinellid Sponges from the Upper Devonian of New York.

—— The Water Biscuit of Squaw Island, Canandaigua Lake, N. Y.

Simpson, G: B. Preliminary Descriptions of New Genera of Paleozoic Rugose Corals.

Loomis, F: B. Siluric Fungi from Western New York.

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- 41 (A5) Beauchamp, W. M. Wampum and Shell Articles used by New York Indians. 166p. 28pl. Mar. 1901. 30c.
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- 44 (EG10) Ries, Heinrich. Lime and Cement Industries of New York; Eckel, E. C. Chapters on the Cement Industry. *In press*.

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- 48 (G4) Woodworth, J. B. Pleistocene Geology of Nassau County and Borough of Queens. 58p. il. 9pl. map. Dec. 1901. 25c.

Volume 10

- 49 (P5) Ruedemann, Rudolf; Clarke, J. M. & Wood, Elvira. Paleontologic Papers 2. 240p. 13pl. Dec. 1901. 40c.
Contents: Ruedemann, Rudolf. Trenton Conglomerate of Rysedorph Hill.
 Clarke, J. M. Limestones of Central and Western New York Interbedded with Bituminous Shales of the Marcellus Stage.
 Wood, Elvira. Marcellus Limestones of Lancaster, Erie Co. N. Y.
 Clarke, J. M. New Agelacrinites.
 — Value of *Amnigenia* as an Indicator of Fresh-water Deposits during the Devonian of New York, Ireland and the Rhineland.
- 50 (A6) Beauchamp, W. M. Horn and Bone Implements of the New York Indians. 112p. 43pl. Mar. 1902. 30c.
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- 53 (E14) Felt, E. P. 17th Report of the State Entomologist 1901. 232p. il. 6pl. Aug. 1902. 30c.
- 54 (B5) Peck, C. H. Report of the State Botanist 1901. 58p. 7p. Nov. 1902. 40c.
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- 55 (A7) Beauchamp, W. M. Metallic Implements of the New York Indians. 94p. 38pl. June 1902. 25c.
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- 57 (E15) Felt, E. P. Elm Leaf Beetle in New York State. 46p. il. 8pl. Aug. 1902. 15c.
- 58 (M2) Whitlock, H. P. Guide to the Mineralogic Collections of the New York State Museum. 150p. il. 39pl. 11 models. Sep. 1902. 40c.
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 Clarke, J. M. Catalogue of Type Specimens of Paleozoic Fossils in the New York State Museum. *In press*.

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State Museum

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Museum memoirs 1889-date. Q.

- 1 Beecher, C: E. & Clarke, J: M. Development of some Silurian Brachiopoda. 96p. 8pl. Oct. 1889. *Out of print.*
- 2 Hall, James & Clarke, J: M. Paleozoic Reticulate Sponges. 350p. il. 70pl. Oct. 1899. \$1, cloth.
- 3 Clarke, J: M. The Oriskany Fauna of Becraft Mountain, Columbia Co. N. Y. 128p. 9pl. Oct. 1900. 80c.
- 4 Peck, C: H. N. Y. Edible Fungi, 1895-99. 106p. 25pl. Nov. 1900. 75c. This includes revised descriptions and illustrations of fungi reported in the 49th, 51st and 52d reports of the State botanist.
- 5 Clarke, J: M. & Ruedemann, Rudolf. The Guelph Formation and Fauna of New York State. *In preparation.*
- 6 Clarke, J: M. The Naples Fauna in Western New York. *In preparation.*

Natural history of New York. 30v. il. pl. maps. Q. Albany 1842-94.

DIVISION 1 ZOOLOGY. De Kay, James E. Zoology of New York; or, The New York Fauna; comprising detailed descriptions of all the animals hitherto observed within the State of New York with brief notices of those occasionally found near its borders, and accompanied by appropriate illustrations. 5v. il. pl. maps. sq. Q. Albany 1842-44. *Out of print.*
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